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# EXPLORATORY TREPHINING AND PUNCTURE OF THE BRAIN ALMOST TO THE LATERAL VENTRICLE,

*For Intracranial Pressure supposed to be due to an Abscess  
in the Temporo-sphenoidal Lobe. Temporary Improve-  
ment; Death on the Fifth Day; Autopsy:  
Meningitis with Effusion into the  
Ventricles.*

*WITH A DESCRIPTION OF A PROPOSED OPERATION  
TO TAP AND DRAIN THE VENTRICLES AS A  
DEFINITE SURGICAL PROCEDURE.*

BY

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PROFESSOR OF SURGERY IN THE WOMAN'S MEDICAL COLLEGE OF  
PENNSYLVANIA; SURGEON TO ST. MARY'S, ST. AGNES'S,  
AND THE WOMAN'S HOSPITALS, ETC.

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AS A DEFINITE SURGICAL PROCEDURE.<sup>1</sup>**

BY W. W. KEEN, M.D.,  
PROFESSOR OF SURGERY IN THE WOMAN'S MEDICAL COLLEGE OF  
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EMMA S., aged fourteen years. Eight years ago Dr. John L. Yard first called me in consultation to see her. She then had hip-joint disease on the right side, from which she recovered with a straight leg, though ankylosed, after about three years of treatment. Later she had several scrofulous outbreaks. Six months or more ago her left ear began to discharge, and this has continued ever since. Her general health also has failed, and in spite of her summer holiday in the country she has returned thinner and paler than usual. About two weeks before I

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<sup>1</sup> Read before the College of Physicians of Philadelphia, Nov. 7, 1888.

saw her she commenced to have pain in her head with some mental dulness, cerebral vomiting, and moderate fever; temperature  $99.6^{\circ}$  to  $101.6^{\circ}$ . Soon some little trouble with her speech developed.

I first saw her September 30, 1888, at 8 P.M. Her temperature was  $101^{\circ}$ ; pulse 72; resp. 16. She had vomited food without nausea for several days. She had had headache for several days, but can scarcely localize it accurately. She had had no chill, no convulsions, and no photophobia. Tapping on the left side of the head scarcely elicits pain at any point, but pressure developed distinct tenderness over an area of about two inches in diameter above and in front of the left ear. There is no œdema of the scalp either at this point or elsewhere. The mastoid is entirely free from pain, tenderness, swelling, or œdema. The child has double vision. There is no ptosis. The tongue, when protruded, deviates slightly to the right. The speech is thick. It is difficult to say whether this is due to some ataxic aphasia, or, possibly, to some paralysis of the tongue. The breath is quite fetid. The internal and external jugulars show no tenderness or hardness. There is no word-deafness; unfortunately, word-blindness was not sought for. The left pupil is much larger than the right and is sluggish in its reaction to light.

Mentally she is rather dull and uncomplaining, in marked contrast to her usual disposition. She has had no irritability.

*Oct. 1, 2 P.M.* Her intelligence has diminished very much—*e. g.*, she seems to apprehend the command to lift her hand, but not to protrude her tongue, and otherwise is very dull, though not sleepy. She has not spoken a word to-day, and only replied "yes," in thick speech, to the many questions we asked her.



Dr. Howard F. Hansell saw her with us to-day, and reports that the vision is unimpaired; the eye-ground shows the veins much congested on both sides, but more marked on the left than on the right, and rapidly developing choked disks. The squint was ascertained to be due to paralysis of the left external straight muscle. The left membrana tympani was destroyed and the canal filled with pus; no dead bone could be discovered. The hearing, unfortunately, was not tested by the watch, but for conversation was only moderately impaired apparently; abdominal reflex was absent; knee-jerk on the left side more marked than the right, but both of them below the normal. She has to-day passed water involuntarily in bed.

*Diagnosis.*—Intracranial pressure, arising probably from abscess in the temporo-sphenoidal lobe with pressure on the left sixth nerve, and, possibly, on the base of the third frontal convolution. Exploratory trephining was recommended and accepted readily by her parents.

*2d.* Her condition has to-day grown rapidly worse, as compared with yesterday. She is unconscious, with sordes on the lips and teeth. Last night Dr. Yard prepared her head for operation in the usual way (see the *American Journal of the Med. Sciences*, October, 1888, p. 335), but by an accident he was not able to take the temperature on the two sides of the head.

*Operation.*—2.15 P. M. Present, Drs. Yard, W. J. Taylor, H. F. Hansell, M. J. Lewis, and Louis Jurist. The operation lasted from 2.45 to 3.32 P. M. No spray was used. During etherization the respiration was shallow and diaphragmatic, so much so, that Drs. Yard and Jurist, who had charge of the patient, sent for me to the room in which she was being

etherized, being doubtful whether it was wise to go on. During the operation the pulse was 124, almost too soft to count. Only one-quarter of a pound of Squibb's ether was used.

The ear was first cleaned and filled with boric acid, I then selected a spot three-quarters of an inch in front of the meatus and an inch and a half above Reid's "base-line" (a line drawn backward from the inferior border of the orbit, through the middle of the meatus, and extended to the occiput), as the place for trephining. I made a small incision through the skin and marked this point with a bone gouge, and then made a flap two inches in diameter with the convexity looking upward, so as keep the most favorable blood supply. The set-screw of my one-inch trephine broke, and I was compelled to use a half-inch trephine, which proved to be quite sufficient.

As soon as the button of bone was removed the dura bulged into the opening distinctly. It pulsed, was very tense and elastic to the touch, and its color was dark. Dr. Morris J. Lewis made the following notes of what was done. I plunged a hypodermatic needle of moderate calibre through the dura, downward and a little forward, to the depth of an inch. Some serum was drawn into the glass barrel of the syringe, but as no pus came the syringe was thrust half an inch further. The suction on it was only ten minims. Small fragments of what I thought was curdy pus were now drawn into the syringe. Subsequent investigation, however, showed this to be some white brain tissue.

1. The dura mater was now opened by a small crucial incision, as I did not intend to close it later. The brain substance immediately bulged to a considerable extent and pulsed.



2. The needle was next introduced directly transversely about one and a quarter inches, but no pus flowed.

3. A grooved director was now substituted for the needle, and was pushed downward and backward to the depth of one and a half inches, till it impinged on the petrous portion of the temporal bone.

4. The grooved director was introduced almost directly downward, till the bone was struck at the depth of one and a quarter inches.

5. The director was next introduced forward, inward, and slightly upward, in the direction of the sella turcica, for a distance of one and three-quarters inches. In this child it almost reached the apex of the temporo-sphenoidal lobe.

6. The grooved director was next introduced downward, and a little forward, till it struck the bone at two inches. No pus was found in any of these six punctures.

7. Thinking there might be an extra dural abscess, a periosteum elevator was now introduced between the dura and the skull directly downward, until the bone was reached. No pus was found.

The incision was then extended directly backward, and a half-inch button was removed at a point one and a half inches above the base-line, and one and a half inches behind the meatus. The dura was not so dark, nor did it bulge so much, nor was it so tense as at the first trephine opening. The needle was introduced forward, downward, and slightly inward, to the depth of one and a half inches, and, secondly, almost directly transverse, but no pus was found. The dura here was not opened.

I next drew down the flap, and examined the mastoid foramen, but could find no evidence of pus. As the symptoms and physical signs did not point to

the cerebellum, I did not trephine there, though I contemplated so doing for a few minutes. I was so convinced that the intra-cranial pressure was due to fluid, and that that fluid was pus, that I introduced a drainage tube transversely, and a little upward, to the depth of one and a half inches, through the first trephine opening, to favor its escape by affording a path of least resistance. The flap was buttonholed for the exit of this tube, and held it firmly in place. Horsehair was placed under the flaps, and catgut sutures introduced. The buttons of bone were, of course, not replaced, nor the dura sewed. A dry sublimate dressing was applied, and the ordinary recurrent bandages used. She was placed in bed in a good physical condition.

Toward the close of the operation the child's respiration was almost entirely diaphragmatic and irregular, somewhat resembling the Cheyne-Stokes type, but not at all marked. In none of the punctures were there any convulsive movements of the right side of the body, other than those that were partially voluntary. Every puncture by the hypodermatic needle sucked up some fragments of white brain-tissue into the syringe.

10.30 P.M. Her condition was very much as it had been the day before the operation. Temperature 101.6°. There has been but slight oozing from the wound. She had taken milk with a little brandy every twenty minutes without any difficulty. She was not entirely unconscious. She had taken up a piece of newspaper lying on the bed, and seemed to make an attempt to look at it, but otherwise she had not shown consciousness. She passed water involuntarily once.

3d. Morning (first day after operation). The moment I saw her when I entered the room I was

struck with the improvement in her appearance. Her eyes were open and she took notice of what was going on around her. She had repeatedly taken a tumbler of milk in her own hands and drunk it. Temperature normal. No inference could be drawn from the pupils as the effect of the atropia had not passed off. At the dressing of the wound she showed appreciation of pain. The wound could not look better. A small amount of oozing and some small flakes of brain tissue were on the dressing, but no pus. The wound was redressed more for the purpose of observation than for surgical reasons. She was in every respect better than at any time since I first saw her. Her squint was still preceptible.

*3d.* Evening. Her intelligence is better than in the morning. When I said "good-bye," she held out her hand. She takes fair nourishment. Recognized her mother and tried to talk. Has passed no water since 5 A.M. Lithia water was ordered.

*4th.* A.M. (second day). Mind not quite so clear as last evening; she noticed the blood-stains on her night-dress, which seemed to cause her distress. Has had no sleep, and has been somewhat restless. Passed water twice. Temp.  $100.6^{\circ}$ , pulse 120.

10.30 P.M. Temp.  $102.4^{\circ}$ , pulse 163. Quite drowsy, and took no notice of change of night dress. Passed water twice since this morning. Slept four hours this evening. Took some milk.

*5th.* 12 M. (third day). Restless all night, no sleep till 5 A.M., since then has slept considerably. Passed water three times in the night. Temp.  $103.7^{\circ}$ , pulse 150. Dressing changed. The wound looks perfectly well; no discharge; drainage tube removed.

7.15 P.M. Rather more intelligent during the afternoon. An enema moved the bowels freely; shook

hands with Dr. Yard when he came in; took no nourishment; passed water twice. Temp.  $103.2^{\circ}$ , pulse 153.

6th. 10.25 A.M. (fourth day). Has taken very little nourishment; passed water twice; almost comatose; breathing labored. Temp.  $104.8^{\circ}$ , pulse 172.

6 P.M. Gradually sank and died at this hour.

*Post-mortem*, Oct. 8th, forty-five hours after death. The wound was well united, though the flaps were easily torn apart. There was no meningitis apparent on removing the skull cap. The bloodvessels were somewhat dilated, those on the right side rather more than those on the left. Slight œdema was noticed in the track of the middle cerebral vessels. On lifting the frontal lobes a great deal of œdema was noticed which obscured the cerebral substance around the peduncles and pons and was so marked over the medulla and cord that they could not be seen until the fluid had escaped, which it did immediately upon removal. Then, saving some injection of bloodvessels, the brain substance and membranes appeared nearly healthy. The œdema extended distinctly to the fifth, to the auditory and facial nerves, and to a less extent also to both optic nerves, all more marked on the left side. There was not the slightest adhesion at any point, either at the trephine openings or on the under surface of the brain; no false membrane.

At the second trephine opening, the point where the two punctures were made was barely recognizable on the cortex, not the slightest adhesion or inflammation being observed. The posterior puncture was through the middle temporo-sphenoidal convolution at its upper border; the anterior in the superior temporal convolution. The point where the drain-

age tube had been inserted through the first trephine opening was patulous. It was not, however, surrounded on the external surface of the cortex by any evidences of inflammation.

Transverse sections of the brain were now made, beginning with the cerebellum, which was perfectly healthy at every point. The sections crossing the track of the drainage tube showed not the slightest trace of inflammation surrounding its track. Only the portion of the brain tissue immediately in contact with the tube was slightly discolored, and possibly softened to a depth of not over one-sixteenth to one-twentieth of an inch in thickness. The length of the drainage canal in the brain itself was one inch. *The internal extremity was within one-quarter of an inch of the distended left ventricle.*

The sections of the brain were made about one-third of an inch apart, and showed entirely healthy brain tissue. Although observations were made with great care and each section cleaned by pouring water over its cut surfaces, not the slightest trace could be found of the punctures made by the hypodermatic needle or the grooved director; no laceration of the tissue; no effusion; no softening; no hemorrhage; nothing to give any evidence that the brain had been touched.<sup>1</sup> The lateral, third, fourth, and fifth ventricles were all very much dilated and filled with serum. The posterior horn of the lateral ventricle was three-quarters of an inch in diameter, and the third ventricle one inch in diameter. There was no inflammation of the dura at any point, not even in the track in which the periosteum elevator

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<sup>1</sup> In the discussion Dr. Osler stated that when examining the specimens with Dr. Griffith, after hardening in Müller's fluid, the line of the puncture was visible. In the fresh brain we could not see it.



had been passed between the dura and the skull down to the bone. There was no caries of the petrous bone.

The only other organs examined were the kidneys. The left one was moderately congested, but normal in consistency; the right kidney normal in every respect. A half ounce of urine was drawn from the bladder which was found to be albuminous. There was no œdema of the face nor other part of the body, which was very much emaciated before her illness.

Dr. J. P. C. Griffith made the following report on the specimens which were given to him for examination :

The membranes covering the medulla, and the portion of cord attached to it were much thickened, and adherent to the tissues beneath. Portions were carefully dissected off in water, stained in hæmatoxylin, and examined in glycerine. Under the microscope there were revealed the evidences of a tubercular meningitis; the tissues being thickened and infiltrated with lymphoid elements, while in certain portions tubercles could be distinctly observed.

REMARKS.—I have reported this case somewhat minutely on account, first, of the question of diagnosis, and, secondly, the surgical treatment. This last is extremely important as showing first that the brain can be explored thoroughly, repeatedly, and deeply without any apparent injury either to its substance or to its functions; and, secondly, that so far as this case enables us to judge, in cases of intracranial pressure and dropsy of the ventricles, it would be easy in the future to trephine and to tap



the ventricles and give exit to the fluid, and possibly effect a cure, without doing any damage to the brain substance.

First, in the matter of the diagnosis, Dr. Yard and I recognized that the trouble was due to intracranial pressure, and the only question was the cause. My own judgment was decidedly in favor of abscess of the temporo-sphenoidal lobe, and for the following reasons:

A scrofulous child, purulent discharge from the ear for six months or more, sudden vomiting evidently cerebral, headache, a tender spot above and in front of the left ear and at no other point, possible aphasia, paralysis of the left sixth nerve, congestion of the optic papilla more marked on the left side, pulse normal, temperature while not normal or sub-normal, but little elevated until a little while before death.

Negatively, I excluded meningitis from the absence of delirium or delusions, the absence of photophobia, of contracted pupils, convulsions, and of facial twitchings, the absence of high temperature, no marked rigidity of the neck muscles, no prior irritability, no injection of the conjunctiva, no grinding of the teeth. I excluded abscess in the cerebellum from the perfect coördination of movements which always existed, and the entire absence of any localized symptoms of cerebellar disturbance. At the operation the examination of the mastoid foramen showed no evidence that the pus had travelled back from the petrous bone toward the cerebellum along the track of the lateral sinus. Although either the presence or absence

of pus at this foramen is not a physical sign on which I would rely too much, yet taken with other signs it is probably of value as pointed out by Mr. Barker.

The motor region was excluded by reason of the entire absence of paralysis, the slight possible paralysis of the tongue being due more likely to the direct involvement of the seventh nerve, as it passed through the petrous bone.

Abscesses in the frontal and occipital lobes were excluded by their great rarity and by the absence of any local symptoms. Mastoid disease was excluded, as there was no œdema or other symptoms of local mischief. Abscess between the dura and the skull would probably have produced œdema of the scalp, which was absolutely absent, and the exploration at the operation demonstrated the non-existence of such an abscess. Plugging of the lateral sinus would have produced hardness and other signs in the internal and external jugular veins, and other symptoms of pyæmia. No such changes or symptoms were observed. It seemed, therefore, both by exclusion, as well as by positive evidence, that there was mischief on the left side, and almost certainly abscess of the temporo-sphenoidal lobe. The presence of pulsation at the trephine opening was extremely significant as against the diagnosis of abscess, and together with the elastic tension and bulging would be of the greatest value in enabling us to diagnosticate effusion into the ventricles. These means of diagnosis, however, are only of value during and not prior to the operation.

The results of the operation show that, saving for

a slight disintegration of the brain tissue in a very thin layer round the track of the drainage tube, the cerebral substance was healthy. A most remarkable thing to my mind was the entire absence, even after the most careful search, of any evidence of puncture in the brain tissue.

In the various punctures I employed a hypodermatic needle in four of them, and a grooved director in four others. When the dura is intact the syringe must be used, but it should be used with great caution on account of the suction, for, though I had a suction cavity of only seven to ten minims in the barrel of my syringe, yet the brain substance was sucked up into it every time. I cannot but think that the introduction of a grooved director would be safer and certainly, as shown by the post-mortem, did no more injury to the brain substance than the syringe itself, with its certain loss of tissue. The grooved director would allow pus or any other fluid to escape by its deep groove. The sharp point of the needle might readily puncture a vein, a large artery, a sinus, or possibly one of the large nerves, but the blunt end of the director exposes us to no such danger, and invites to a more extended and thorough exploration.

That this is not a merely theoretical objection to the needle is shown by Beck,<sup>1</sup> who relates a case of hemorrhage into the lateral and fourth ventricles as a result of its use, and by Dr. B. A. Watson, who tells me that in his researches on puncture of the

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<sup>1</sup> Bergmann: Chir. Behandl. Hirn Krankh., p. 52.

heart as a therapeutic measure, such needle-punctures of the vena cava were invariably followed by hemorrhage. Even the introduction of a drainage tube into the brain, in a case operated on by Weir, has been followed by fatal secondary hemorrhage from injury to the middle cerebral vessels.<sup>1</sup> I believe that the grooved director might be fearlessly passed in until it touched the base of the skull, or to the falx or tentorium, provided that important cortical centres, the internal capsule, or the great basal ganglia, are not in its path. It is, I fear, only too probable that these structures would be an insuperable barrier to any such puncture; but even this is a question that can only be decided by trial—a trial, however, that should be most cautiously made, first upon animals and then upon man, and even then in the human subject only when forced upon us by circumstances. I am perfectly well aware that the tendency is to substitute the knife for the syringe, and that v. Bergmann has even formulated it as a rule. This, as an operative procedure, or for superficial exploration, has my entire assent. But for *deep* exploration I am convinced that we shall do less harm by the director; and that as it is less dangerous we shall be more thorough in our explorations with it, and so learn much more than by the knife.

In the use of any instrument, whether a grooved director or a needle, the greatest care should always be exercised to insert it in a direct line, and to withdraw it in the same line so as not, by a lateral sweep, to lacerate the brain substance.

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<sup>1</sup> THE MEDICAL NEWS, Oct. 6, 1888, p. 401.

PROPOSED TAPPING OF THE VENTRICLES AS A  
DEFINITE SURGICAL OPERATION.

As a result of my observations in the present case I would definitely propose in any similar case of dropsy of the ventricles, or of abscess in them, that tapping of them be done as a systematic operation.

In some very brief remarks at the late Washington Congress, I drew attention to the analogy between the cavity of the head and the cavities of the chest and abdomen. In the latter two we recognize various viscera, differing in functions and location, and recognized each by its own physical signs. We recognize, also, their diseases by symptoms and physical signs differing for each organ, and these differences enable us to diagnose disease of this or that viscus. In the cavity of the head we have recognized too much only one viscus—the brain. But, I argued, the various cortical areas or centres should be regarded as analogous to so many viscera, fused into one mass physically, differentiated functionally. We can recognize disease of the arm, or face, or speech-centres by the differing locality of the lesions, and by the differing symptoms, as palsy of the face, or the arm, or aphasia, no less than by means similar we recognize diseases of the stomach, or liver, or kidney.

I would go further now, and draw a similar analogy between the serous membrane of the abdomen and that of the brain, and plead for a similar treatment for both in case of similar diseases. As we now open the belly and drain in tubercular



peritonitis with such remarkable success, I would propose that we do precisely the same for the brain. That it can be done with precision and without serious injury to the cerebral tissues the history of the present case, I think, abundantly shows; that it is even *more* urgently necessary in the brain than in the chest or belly seems clear when we consider the relative effects of pressure in the two cases. In the chest or belly the walls are more or less yielding, and the viscera hollow or spongy, to a large extent. They can bear great and long-continued pressure with but little damage to their ultimate integrity, or to life, if the pressure be relieved within any reasonable time.

Not so in the cranium. The walls are rigid bone, and the brain can undergo but little pressure, and for a brief time (except it be gradual, as in chronic hydrocephalus) without inviting death. The fatal issue is so uniform that *any* means that holds out a reasonable hope of relief, even though it involve great risk to life, should at least be tried; and the proposal in the present paper seems, at least, to involve but a moderate danger to life with a reasonable probability of success.

It may be objected that much draining of cerebrospinal fluid would be dangerous. I answer, first, we do not know till we try. Secondly, in my brain tumor case (*American Journal of the Medical Sciences*, Oct. 1888) there was probably a very slight wall between the cavity occupied by the tumor and the lateral ventricle. This wall subsequently ruptured, and gave exit daily to a quantity of cerebro-

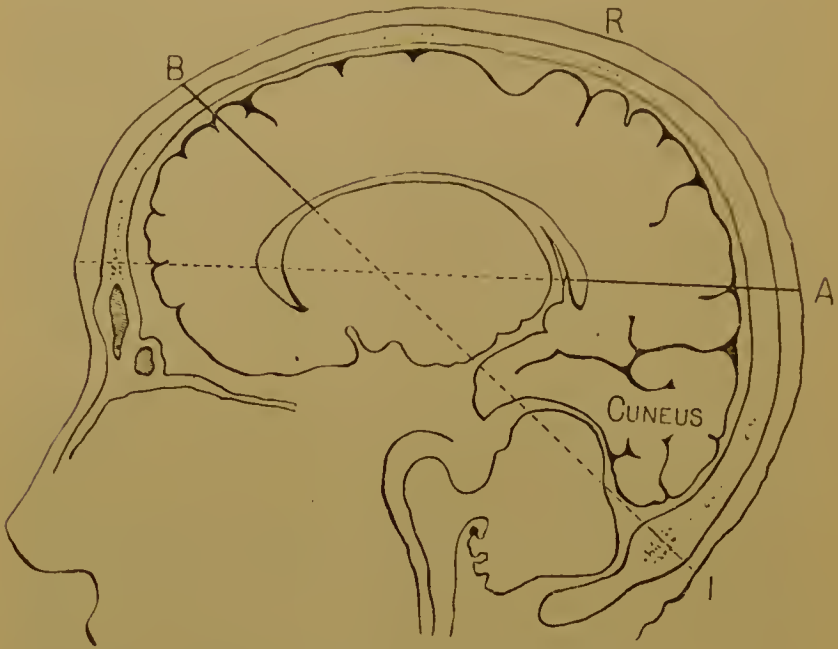


spinal fluid sufficient to wet an ample sublimate dressing continuously for three weeks. In Mr. Horsley's case of spinal tumor the same abundant drainage continued for a long time. In the *Comptes Rendus* (1888, cvi. 1693) Lucas Championnière reports a case in which no ill results followed such an abundant flow of the cerebro-spinal fluid as to wet the dressings, the pillow, and the bed. Such abundant and long-continued drainings do not, therefore, seem to be a danger. Thirdly, experience may show us that possibly in the head, as in the abdomen, simple evacuation of the fluid without its continuous drainage, may be not only feasible, but best. Of course, for pus in the ventricles the drainage should be prolonged, if, indeed, so fatal a lesion allow of any treatment.

As to the technique, I have made some dissections and trials on the cadaver, with the help of Dr. Wm. J. Taylor, with the following results: We must avoid (1) the motor zone; (2) the neighborhood of the fissure of Sylvius, on account of the middle meningeal and middle cerebral arteries and their branches, and also because access to the ventricle can only be had here through the island of Reil and the basal ganglia. Hence, the first trephine opening in the present case should be rejected as unsuitable. But it must be remembered that it was chosen in this case not to puncture the ventricle, but the temporo-sphenoidal lobe. Only the wide distention and overlapping of the lateral ventricle, in fact, saved me from doing harm, I suspect, by my drainage tube. (3) We must avoid known sense-centres,

and utilize, so far as other considerations allow, the so-called "latent zones."

FIG. 1.



(Drawn by Dr. John M. Taylor.)

Antero-posterior section of the head one-half inch from the middle line. R, fissure of Rolando; I, inion; A and B (solid), the lines of puncture, the dotted lines showing their imaginary continuation to the opposite fixed points.

Moreover, the way in which punctures are described in this present paper, and most others, is extremely inexact and unsatisfactory. The exact point of the trephine opening is noted, and then the puncture is described as "downward and forward," "forward and a little inward," etc. I propose to substitute for these loose descriptions,

the exact point on the skull at which the line of puncture would emerge were it prolonged.

Provisionally, therefore, and until experience will show us better, I would propose three routes as practicable.<sup>1</sup>

I. Trephine half-way from the inion (the external occipital protuberance) to the upper end of the fissure of Rolando, half to three-quarters of an inch to either side of the middle line. Puncture toward the inner end of the supraorbital ridge of the same side (Fig. 1, A). The puncture will pass through the precuneus, and the normal ventricle will be struck at some point in the posterior horn at from two and a quarter to two and three-quarters inches from the surface of the scalp.

II. Trephine at one-third of the distance from the glabella to the upper end of the fissure of Rolando, and half to three-quarters of an inch to either side of the middle line. Puncture in the direction of the inion (Fig. 1, B). The puncture will traverse the first frontal convolution well in front of the motor zone, and the normal ventricle will be struck in the anterior horn at about two to two and a quarter inches from the scalp.

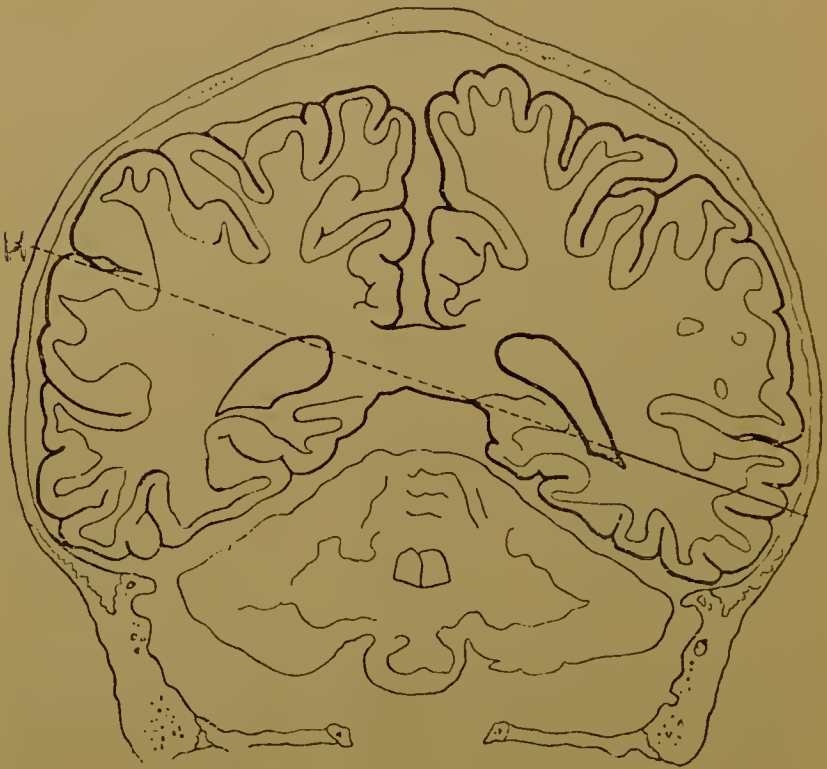
III. Trephine one and a quarter inches behind the meatus, and one and a quarter inches above

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<sup>1</sup> Dr. Harrison Allen (The American Journal of the Medical Sciences, July, 1873, p. 224) proposed at autopsies to examine the fluid in the ventricles "by a vertical incision made from the vertex of the brain about six lines to the outer side of the great longitudinal fissure," an incision that will always reach the ventricles, but would injure the motor centre crucially.

Reid's base-line. Puncture toward a point two and a half inches directly above the opposite meatus (Fig. 2). The puncture will traverse the second

FIG. 2.



(Drawn by Dr. John M. Taylor.)

Transverse section of the head one and a quarter inches behind the meatus. The continuous line shows the line of puncture, the dotted line its imaginary continuation to the opposite side of the skull.

temporo-sphenoidal convolution, and enter the normal lateral ventricle at the beginning, or in the course of the descending cornu at a depth of about two to two and a quarter inches from the surface.

I have endeavored to give these points for trephining less in inches than in proportionate parts between fixed points, which is the better method. In the third route the measurements are for an adult skull, and are to be somewhat reduced for children. The depth necessary for the puncture can only be stated approximately (*a*) on account of the point of emergence into the ventricle varying with slight differences in direction; (*b*) on account of different thickness of the skull, and overlying soft parts; and (*c*) variations in the diameter of the entire skull from youth to age, and also in different adults. All these are measurements to a normal ventricle. In a distended ventricle from effusion the distances would be proportionately less.

The posterior route has the advantage of better drainage. But whether this will be really an advantage is a question. Experience may prove that evacuation of the fluid without drainage may be best. It avoids the cuneus and will not therefore produce hemianopsia.

The anterior route has two disadvantages: first, the scar on the forehead, and, secondly, unless great care is used in directing the puncture and its depth, the corpus-striatum may be injured. Compared with the danger of the disease the first objection is slight, and in a distended ventricle the second would lessen *pari passu* with the degree of the distention. The advantages are that it is high enough to avoid the frontal sinus, injures no known centre, and if evacuation and not drainage be desired this will easily give it.



The lateral route has the great advantage that, in a case like the one here reported, in which there might be a reasonable doubt as to whether there was an abscess of the temporo-sphenoidal lobe, or dropsy of the ventricles, both explorations could be made from one trephine opening. It could either be made to favor drainage if dependent, or to hinder it by lying with the operated side up. It penetrates a possible centre for hearing of the opposite side, but as it has been utilized for puncture in a number of cases of abscess, in the temporo-sphenoidal lobe, and no ill result has followed as to hearing, this objection would seem to vanish. At the ventricular end of the puncture it has the danger of possible injury to the thalamus, but this, I suspect, in a distended ventricle would not be very great. On the whole, I should at present favor this route until we find a better one.

An inch or a half inch trephine opening having been made, the dura should be examined. If it pulsate, bulges in the wound, and is tense and elastic to the touch, it will confirm the diagnosis; should it be tense, elastic, and bulging, but not pulsate, abscess or tumor should be suspected and sought for. The diagnosis of dropsy of the ventricles having been confirmed, the dura should be incised conically and the grooved director now be introduced in the direction, and about the depth above indicated, unless fluid is found more superficially. If the first puncture does not reveal fluid, a second or a third may be made. When found, it should be evacuated by the



introduction of a dressing or hemostatic forceps. I should then introduce a drainage tube for twenty-four hours or more, according to circumstances. The rest of the treatment would be the usual one in brain cases.





